

to your local traffic jam, to the queue, wherever it may be—take it wherever you're apt to have a few moments to spare—each essay is self-contained, and each is a tidbit that can be read in a few minutes but savored considerably longer.

Franklin M. Branley
The American Museum—Hayden Planetarium, New York

Micromechanics of Flow in Solids

By J. J. Gilman
 294 pp. McGraw-Hill, New York, 1969.
 \$15.00

Plastic flow is a macroscopic result of the motion of dislocations. The author, who published many papers on this motion, gives a summary of his work (and of the related publications by other scientists) in chapters 5 to 9 of this book. The first four chapters form a kind of introduction; their titles are: Introduction, Review of Elastic Behavior, Crystal Plasticity and Dislocation Geometry (the longest in the book). Of necessity, they are rather condensed, and the justification for many equations has to be looked for elsewhere in the literature (indicated by the author).

Many idealized models are considered and a great many equations given. The comparison with experimental data is not extensive; thus, of the 67 figures of chapter 4 only one presents an observed phenomenon, and two of the nine figures of chapter 5 refer to experimental results. In this respect, the volume is not greatly different from many other publications on solid-state physics and would be a very valuable survey of the theory of dislocations that is so important for strength and plasticity.

Unfortunately, the publisher's work is not as good as the content would deserve. Again and again, symbols appear in equations without any definition; two different symbols mean one quantity on one page; a misprint mars the very earliest equation (page 9) and many more stop the reader later on.

J. J. Bikerman
Shaker Heights, Ohio

Variational Principles in Heat Transfer: A Unified Lagrangian Analysis of Dissipative Phenomena

By M. A. Biot
 185 pp. Oxford U. P., New York, 1970. Cloth \$12.80, paper \$6.40

Except for isolated cases, few of the equations of mathematical physics can be solved in terms of known functions. And of the techniques available to generate approximate solutions, undoubt-

edly the most useful are based on applications of one or another variational principle. It is interesting that although variational principles for the description of dissipative processes were first proposed long ago by Hermann von Helmholtz and Lord Rayleigh, they have only recently become subject to active investigation. *Variational Principles in Heat Transfer*, by Maurice Biot, collects the author's work on a unified analysis of heat transfer, including convection and conduction. The key idea is a generalization of the virtual-work concept; one consequence is the generation of variational equations containing terms analogous to generalized forces as in the Lagrangian formulation of mechanics. As is to be expected, the structure of the equation is suggestive of approximations. Several of these are worked out and shown to be accurate. The ideas involved are extendable to the discussion of other dissipative phenomena.

This is a personal book, giving an account, primarily of the author's work. Although other variational principles are very briefly discussed (for example, those of Prigogine-Glandsdorf and Galerkin) little effort is made to compare them with the author's approach. This is a pity, since some of the most interesting ideas in the theory of dissipative processes, for example the collection of phenomena labelled "dissipative structure," are aptly discussed in terms of variational principles. A description of that work, and its connection with the analysis presented, would have enriched the book.

This clearly written monograph will be of interest and value to all those fascinated by dissipative phenomena. I recommend it to them.

Stuart A. Rice
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 University of Chicago*

Particles, Sources and Fields

By J. Schwinger
 425 pp. Addison-Wesley, Reading, Mass., 1970. \$14.95

Any book by Julian Schwinger must be regarded as something of an event. No active physicist has contributed more to a larger variety of fields of theoretical physics than he has, and no one has been at it longer. Schwinger began doing original calculations with the Dirac equation while still a teenager in high school.

Schwinger's book is a systematic presentation of source theory—the Cambridge locals seem to refer to it as "sorcery"—as it applies to particle physics. The main idea is to separate particle phenomenology from particle structure. From a phenomenological point of view, particle interactions involve the creation



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Physical Science: a systematic approach

Francis McCarthy, Joan Brenner, and Maurice Temple, all of Boston State College. 1972, est. 490 pp. For the non-science major, a lucid, understandable physical science text. The authors present topics from Physics, Chemistry and Astronomy, stressing the ways that knowledge has been accumulated in these fields.

"Thanks for a book that was fun to read. . . It should be happily received by the people who will learn and teach from it. It is as good as I have seen, in most respects, and in some it is definitely superior."—Daniel G. Reiber, Indiana University of Pennsylvania, from a pre-publication review.

also

An Introduction to Physics

Phillip W. Alley and Robert L. Sells, both of the State University of New York, at Geneseo. 1971, 366 pp. This text is written for a one-semester physics course for non-science students. The mathematical level does not go beyond simple algebra, and the amount of material is restricted in order not to overwhelm the student. Topics are general, relevant, and basic to an understanding of the concepts of physics. An instructor's manual is available.

and

Fundamentals of Atomic Physics

1971, est. 750 pp. A fundamental, yet rigorous account of Atomic Physics, ranging in scope from relativity to Band Theory and its applications. Problems of varying difficulty are included at the end of each chapter.

Fundamentals of Nuclear Physics

1966, 646 pp., 18 pp. of appendixes. Includes both an elementary and an intermediate treatment of nuclear physics. Background material is approached historically.

Both by Atam P. Arya, West Virginia University.

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of particles and their ultimate annihilation in a detector of some sort. Theoretically, one would like to be able to predict the probability of the occurrence of such a sequence. In quantum field theory of the conventional type, the sources are particles to be associated with the quantum states of some field. In sorcery, these source particles are replaced by source functions, real-valued ordinary functions of space-time, whose general characteristics can, to some extent, be fixed by the symmetries, Lorentz covariance and other factors assumed to hold for the theory. The object of the game is to determine the probability of a vacuum-vacuum transition in the presence of these sources. For weak sources a perturbation theory is available and, by a very ingenious series of arguments involving the causal requirement that particles cannot be absorbed before they are emitted, Schwinger derives the terms in the series which involve the causal Green's functions familiar from field theory. The significant feature of this expansion is that at no stage is any appeal made to a field-theory Lagrangian or to quantized fields. On the other hand the source functions are primitive phenomenological entities, at least on the level of presentation of the present book. We are not invited to take apart the sources, as one would try to do in a normal field theory. Perhaps in a subsequent volume Schwinger will tell us how to use source theory to compute, say, the Schwinger magnetic moment of the electron. At the level of phenomenology of this book this, as far as I can determine, is put in by hand as a phenomenological parameter.

The book is written in a cheerfully polemic tone. (There are occasional dialogues with an interlocutor called "Harold"—once addressed, *à la* Galileo, as Sagredo—who gets mowed down each time he puts his hand up to ask a question.) It is addressed to what I might refer to as Consciousness III graduate students who are both sufficiently smart so as to be able to read it, but whose minds have not been warped "past the elastic limit" by previous exposure to operator field theory or S-matrix theory. Perhaps such students exist at Harvard, but, as for myself, I did not find the book easy going. Schwinger is such a virtuoso at calculational techniques that to him, no doubt, the extension of sorcery from spin one to spin three fields is a simple exercise. I found it a calculational Mount Everest and, perhaps, it, and some of the other more abstract examples, might have been relegated to appendices. On the other hand I found his presentation of spin-half scattering processes by means of helicity techniques absolutely beautiful and instantly stole some of his derivations for my

course in advanced quantum mechanics. These techniques apparently have nothing, to do with the underlying source philosophy, and anyone whose mind is already too warped to forget what he has learned from field theory can start, for example from page 286, where he will find a familiar-looking expression and then proceed to see how Schwinger works with it. In doing so he will find himself led backwards into the book and soon he will be swimming happily among the sources.

As elementary-particle theory has become more and more polluted by the emissions of advanced mathematical technology, books about it have become stuffier, more obscure and less and less fun to read. Schwinger's book, while not easy reading, is—because of the unconventional personal tone epitomised in his motto "If you can't join 'em, beat 'em" and because of the elegance and power of his calculational methodology—fun to read. Whether source theory will lead to profound new discoveries of the type that Schwinger, and others, have made using conventional field theory remains, I think, to be seen. Perhaps Schwinger has some surprises up his sleeve for the next volume that will settle the matter.

Jeremy Bernstein

Stevens Institute of Technology
Hoboken, New Jersey

The Collected Works of Count Rumford, Vols. 3, 4, 5

S. C. Brown, ed.

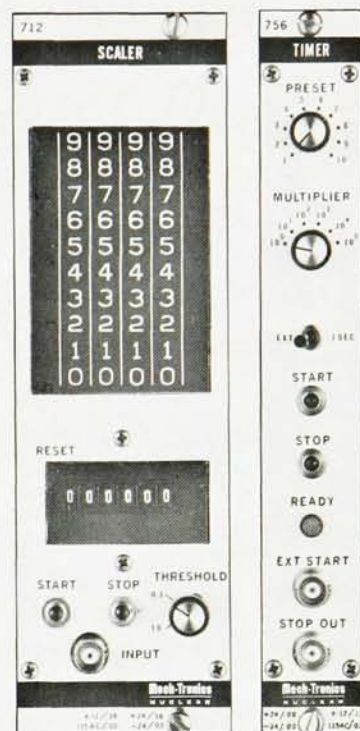
504 pp., 503 pp. and 512 pp.
Harvard U. P., Cambridge Mass.,
1969, 1969, 1970. \$10.00 each.

These volumes continue the presentation of Count Rumford's work that was begun in volumes 1 and 2. Rumford's masterful understanding of the science and technology that interested him is clearly demonstrated by these collected works.

Volume 3, *Devices and Techniques*, is devoted primarily to the practical application of heat, but it also includes pioneering scientific considerations on the importance of steam as a heat-transfer medium. Problems he considered include improved means of heating meeting halls, houses and public buildings and supplying heat for industrial processes, all by methods utilizing the increased heat-transfer efficiency through the use of steam. There is a long detailed paper giving original designs for kitchen stoves, fireplaces, ovens and cooking utensils for large-scale food preparation. This was a major concern of Rumford's during his

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